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(54) [Name of the Invention]

Ceramic Roller and Its Manufacturing Method

(57) [Summary]

[Goal]

The goal of the present invention is to suggest a ceramic roller whereby the cost reduction at the time of the polishing processing is designed and where together with that the lubricating properties are also good; and to suggest its manufacturing method.

[Structure]

A ceramic roller 3, which is characterized by the fact that it is a roller where the rolling (rotating) surface 3a and the end (edge) surface 3b are polished (ground) and together with that the chamfered surface part 3c is not ground, and the non polished sintered surface that remains on the above chambered surface part has a roughness that is rougher than the above described rolling surface and edge surface; and a manufacturing method for the manufacturing of the above described ceramic roller, which contains the following technological processes: the roller material processing technological process whereby a ceramic powder molded material is processed so as to form a cylindrical shape and also to have a chambered surface part at the corner part, the sintering technological process whereby the above roller member is sintered, and the grinding technological process whereby the rolling surface and the edge surface of the above sintered roller member are subjected to a grinding (polishing) technological process and together with that leaving sintered surface on the above described chamfered.

[Scope of the Claims]

[Claim 1]

Ceramic roller characterized by the fact that that it is a roller where the rolling surface and the edge surface are polished and together with that the chamfered surface part is not ground, and the non polished sintered surface that remains on the above chambered

surface part has a roughness that is rougher than the above described rolling surface and edge surface.

[Claim 2]

Manufacturing method for the manufacturing of ceramic roller, which contains the following technological processes: the roller material processing technological process whereby a ceramic powder molded material is processed so as to form a cylindrical shape and also to have a chambered surface part at the corner part, the sintering technological process whereby the above roller member is sintered, and the grinding technological process whereby the rolling surface and the edge surface of the above sintered roller member are subjected to a grinding technological process and together with that leaving sintered surface on the above described chamfered.

[0001]

[Technical Application Field]

The present invention is an invention about a ceramics manufactured roller used for bearing and it is about its manufacturing method.

[0002]

[Previous Technology]

Silicon carbide (SiC), or silicon nitride (Si3N4), etc., fine ceramics have been used as high temperature – high strength materials for mechanical parts. The parts manufactured from these fine ceramics can be manufactured according to the technological process that is presented in Figure 3. Namely, the raw materials that can be manufactured by artificial synthesis (for example, SiC,.Si3N4, etc.), are prepared, combined and pulverized, and this material is made into a certain grain size material (granulation), and after that a metal die molding, or rubber pressing or injection molding, etc., (molding) are conducted, and the mechanical processing into a predetermined shape (primary processing) is conducted, and after that sintering (annealing) is conducted, and then this especially is subjected to a high pressure sintering method (hydro-thermal pressure method, so –called HIP method, or thermal – high pressure method, so-called HP method) and the obtained by this sintered material is then subjected to different types of non-destructive inspections for the material phases and the material passing the inspection is subjected to a polishing process using a diamond polishing stone (secondary processing), and for example the final manufactured part is a bearing roller.

Moreover, depending on the bearing conditions, there are also cases where the pressure sintering method is not used.

[Problems Solved by the Invention]

In the case of the general ceramics bearings using ceramic manufactured parts for all their structural parts, or in the case of the composite ceramic bearings where some of the parts are manufactured from ceramics, there are the problems that as the rolling body of the bearing is a ceramic cylinder roller or a ceramic needle shaped roller, these ceramic cylinder rollers or the chamfered surface parts of the ceramic needle shaped rollers after the sintering (namely, the sintering by using the high pressure sintering method or the normal pressure sintering method) are subjected to a polishing processing using a diamond grinding wheel and because of that the cost becomes increased, and also, there are the problems that it is said that the long time maintenance of the lubricating agent at the time of use, is difficult. The present invention has been generated in order to solve these problems, and its goal is to suggest a ceramic roller whereby the cost reduction at the time of the polishing processing is designed and where together with that the lubricating properties are also good; and to suggest its manufacturing method.

[0004]

[Measures in Order to Solve the Problems]

Namely, according to the present invention, in order to solve the above described problems (1) the ceramic roller is characterized by the fact that that it is a roller where the rolling surface and the edge surface are polished and together with that the chamfered surface part is not ground, and the non polished sintered surface that remains on the above chambered surface part has a roughness that is rougher than the above described rolling surface and edge surface; and (2) the manufacturing method for the manufacturing of ceramic roller is characterized by the fact that it contains the following technological processes: the roller material processing technological process whereby a ceramic powder molded material is processed so as to form a cylindrical shape and also to have a chambered surface part at the corner part, the sintering technological process whereby the above roller member is sintered, and the grinding technological process whereby the rolling surface and the edge surface of the above sintered roller member are subjected to a grinding technological process and together with that leaving sintered surface on the above described chamfered.

[0005]

[Effect]

If the ceramic roller pertaining to the present invention is manufactured according to the above-described method, in the case of the above roller the chamfered part that remains in the unpolished state has a front surface that is in a rough state and because of that it becomes easy to hold the lubricating agent. If as in this case the lubricating agent is held onto the chamfered surface at the time when the lubricating conditions become poor, the chamfered surface part serves a function as a supply source for the lubricating agent. Also, if the manufacturing method for the manufacturing of ceramics bearing roller

pertaining to the present invention is conducted according to the above described method, it is possible to eliminate the polishing process of the chamfered part, which requires time and labor during the final processing, and because of that it is possible to design a decrease of the cost.

[0006]

[Practical Examples]

Here below, the detailed practical implementation examples of the present invention will be explained by using the shown diagrams as reference. Figure 1 is a partial sectional view diagram showing the ceramic roller according to the present invention in a state where it is placed in a bearing; Figure 2 is an enlarged diagram of one part of the above ceramic manufactured roller. In the case of the roller according to this practical example the cylindrical roller 3 is placed in the space between the outer axis 1 of the roller and the inner axis 2 (the holding parts are omitted).

[0007]

The above-described cylindrically shaped roller 3 is manufactured according to the described below manufacturing process. First, in the material processing technological process, the raw material powder is granulated and after that it is subjected to the molding technological process. As the raw material powder Si3N4 or, ALN, or BN, or TiN, etc., nitride materials, SiC, or B4C, or WC or TiC, etc., carbide materials, or Si4-zAlzOzN3-z or Si-M* - O – N (here M*: Be, Li, Mg), etc., oxide-nitride materials, and especially, Al2O3 or ZrO2 – Y2O3 or Al2O3 – ZrO2, etc., oxides can be used. After that the part that becomes the cylindrically shaped roller 3 after the molding technological process is used and by applying a mechanical processing (primary processing) it is processed so that a preliminary cylindrical shape that is almost as the shape of the final manufactured part is formed and also in the corner part a chamfered part is formed with a predetermined radius r. Moreover, as the forming method, it is possible to use any one of the pressure molding method, the hydrostatic pressure molding method, the press forming (molding) method, the injection molding method, the mud solution casting molding method, etc.

[0008]

The cylindrical shape member that is manufactured according to the above described molding and mechanical processing and that has a shape that is almost the same as that of the final manufactured product, and also that has a chamfered part formed on its corner part, is subjected to the sintering technological process, namely, sintering is conducted by a sintering technological process using sintering and elevated pressure sintering-bonding method, or normal pressure sintering-bonding method. Within the elevated pressure sintering-bonding method, there are the hot press method (HP method) and the hot isostatic press method (HIP). In the case of the HP method, it is a method where the raw material powder where a sintering aid agent has been added is introduced in a mold and as it is heated it is pressed and by that it is a sintering-bonding method where elevated

pressure is applied in one axial direction, and it is a good option if the sintering temperature is also low. Also, within the HIP method there is the capsule method where the raw material powder with an added sintering aid agent is introduced into a vessel made from glass, etc., which softens at the sintering temperature, and from the outside of that by using a high pressure fluid the pressure is elevated and the sintering-bonding is conducted, and there is the non-capsule method where the powder molding material is preliminarily sintered until the remaining porosity becomes closed type porosity and after that it is sintered-bonded in a high pressure gas. The cylindrical roller 3 according to the present invention can be made according to any of these methods. Regarding the normal pressure sintering method, it is a sintering method conducted in a normal pressure or reduced pressure gas ambient environment, and it is appropriate for the large scale manufacturing of complex shape manufactured parts. The manufactured by such sintering technological process cylinder shaped material where on the corner part a chamfered surface part has been formed is subjected to a polishing (grinding) technological process and the cylindrical roller 3 is produced, however, in this case also, as it is shown according to the presented in Figure 2, it is a polishing technological process that is conducted so that the chamfered surface part 3c remains unpolished.

[0009]

Regarding the above described cylindrical roller 3, after the sintering-bonding by using the elevated pressure sintering-bonding method or the normal pressure sintering-bonding method, it is polished by using a diamond polishing wheel, however, in the case of the cylindrical roller 3 that is the subject of the processing, even when a suitable strength diamond wheel is used sufficient time and labor, are required. Then, as it is shown in Figure 2 and Figure 3, only on the rolling surface 3a and the edge surface 3b a polishing processing is conducted to a polishing rate t, and the chamfered surface part 3c remains in its unpolished state. Consequently, for the chamfered surface part 3c the C1 and C2 parts remain in the state as they are unpolished (unpolished) and they are processed at the predetermined dimensions and surface roughness. Usually, the surface roughness of the rolling surface 3a and of the edge surface 3b is within the range of 0.2 ~ 0.6 Z. Moreover, Figure 3 is an enlarged diagram showing the view of the polishing rate t for the sake of explanation, however, in practice, it is only a light polishing rate. Consequently, this unpolished state chamfered surface part 3c is a part that does not come in contact with the inter/external axes or with the surface of the holding part.

[0010]

If the ceramic manufactured roller according to the present invention that is used for bearing is made to have the above described structure it is possible to eliminate the polishing technological process of the chamfered surface part, which requires the most time and labor within the polishing technological process, and because of that it is possible to lower the manufacturing costs. Also, for the chamfered surface part that is left in an unpolished state, the surface is in a rough surface state such that it is several times ~ several tens of times rougher than the polished rolling surface 3a or polished edge surface 3b, and because of that it is easy to hold the lubricating agent. This way, it becomes easy

to hold the lubricating agent in the chamfered surface part and because of that at the time when the lubricating conditions become poor, this chamfered surface part becomes a part that serves the function as a supply source for the lubricating agent. Moreover, according to this practical example, an explanation has been provided regarding a cylindrical shaped roller or a needle shaped roller, however, a conical shaped roller is also practically possible.

[0011]

[Results From the Present Invention]

The ceramic roller according to the present invention and its manufacturing method have the above described structure and because of that it is possible to significantly decrease the manufacturing costs of the ceramic cylindrical shape roller or needle shaped roller used for bearing. The chamfered surface part of the ceramic roller according to the present invention does not come in contact with the internal/external axes and with the supporting part and because of that even if a non-sintered layer is present there is no scratching and there is no effect on the working life as a bearing. Also, the chamfered surface part becomes a part that has a function of holding the lubricating agent and because of that here it becomes a supply source for the lubricating agent and the lubricating effect in the space between the cylindrically shaped roller or the needle shaped roller travel surface (the inter/external axes), and the holding part, becomes high.

[Brief Explanation of the Results]

[Figure 1]

Figure 1 is a partial sectional view of the state of the ceramic roller according to the present invention when it is placed on the bearing.

[Figure 2]

Figure 2 is an enlarged diagram of one part of the ceramic roller according to the present invention.

[Figure 3]

Figure 3 is a schematic diagram showing the manufacturing technological process for the ceramic roller according to the present invention.

[Explanation of the Signs]

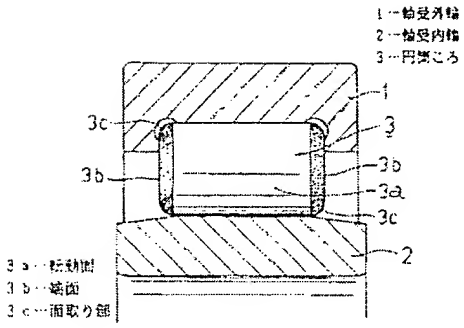
1.....bearing outer axis
2.....bearing internal axis
3.....cylindrical roller
3a.....rolling surface

3b.....edge surface
3c.....chamfered surface part

In Figure 3:
Notations: 1. molding, 2. raw materials, 3. compounding/pulverizing, 4. granulating, 5. metal die molding, 6. rubber press, 7. injection molding, 8. HIP method, 9. HP method, 10. mechanical processing (primary processing), 11. sintering/bonding (sintering/molding, 12. grinding (polishing) technological process (secondary processing).

Patent Assignee: Koyo Seiko Co. LTD.

【図１】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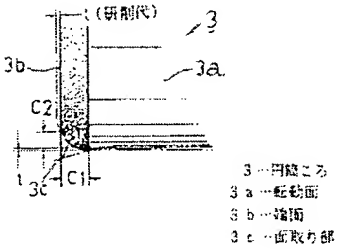
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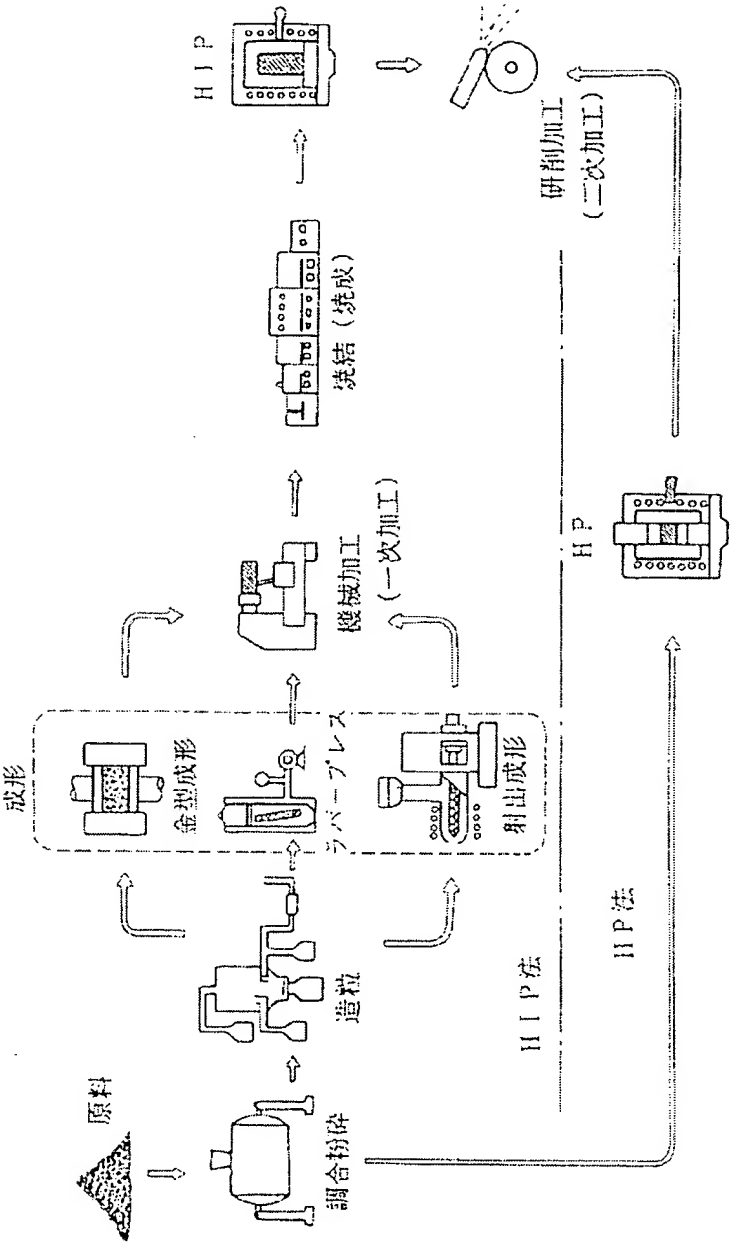
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HIP
研削加工
（二次加工）
HIP
HIP法
HIP法